Op-Amp Adds Short-Circuit Protection to High-Side Switch

High-side switches provide a basic method for extending battery life. They eliminate unnecessary power consumption by simply removing supply voltage from peripherals and subsystems when the circuits are not in use.

The logic-controlled switch circuit of Figure 1 provides output short-circuit protection in addition to low-impedance switching and low quiescent current. The actual switch (Q_1) is an n-channel MOSFET with a gate drive (V_{BATT} +10V) generated by the regulated charge-pump IC_1.

Turn on the circuit by applying V_{BATT} to the ON/OFF input. V_{OUT} (pins 9 and 10) then pumps up, reaching V_{CC} +10V within a millisecond or so and providing power to the IC_2 op amp. To ensure that Q_1 remains off until sufficient gate drive is available, a threshold detector internal to IC_1 triggers a 0V-to-V_{BATT} transition at PR (pin 6) when the rising output equals V_{CC} +8V.

The appearance of V_{BATT} at the PR terminal produces 0.75(V_{BATT}) at the low-power op amp's inverting input and a 100msec pulse at the non-inverting input. The pulse (of amplitude V_{BATT} minus one diode drop) kickstarts Q_1 into conduction and connects the battery to the load. The amplifier (configured as a comparator) then compares Q_1's source voltage with the inverting-input voltage. As long as the source voltage is more positive, Q_1 remains on.

Feedback through R_4 provides short-circuit protection. If excessive load current pulls the source voltage below the reference level at the inverting input, the gate drive goes low and turns off Q_1. Collapsing load voltage then latches the switch off. To reset, pull the ON/OFF input to ground (for at least 100msec) and back to V_{BATT}.

(Circle 4)

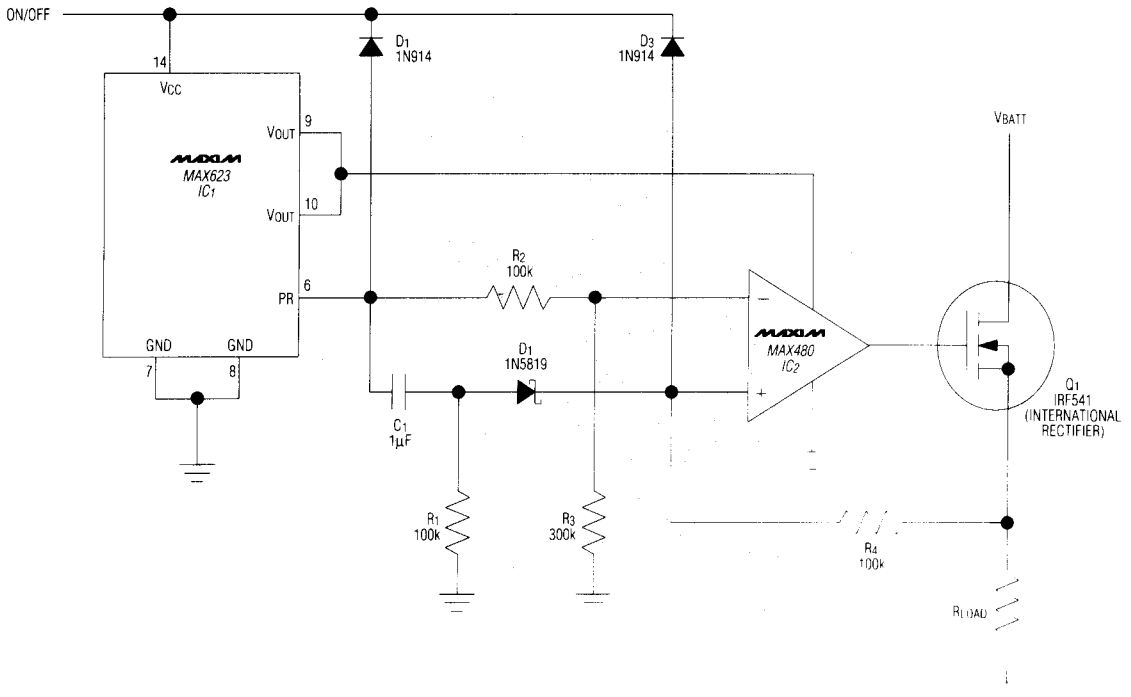

Figure 1. The regulated IC_1 charge-pump generates a gate drive of V_{BATT}+10V for the high-side power switch Q_1 (an n-channel power MOSFET). Feedback via R_4 provides short-circuit protection.